Ecosystem-scale conservation planning in Puget Sound

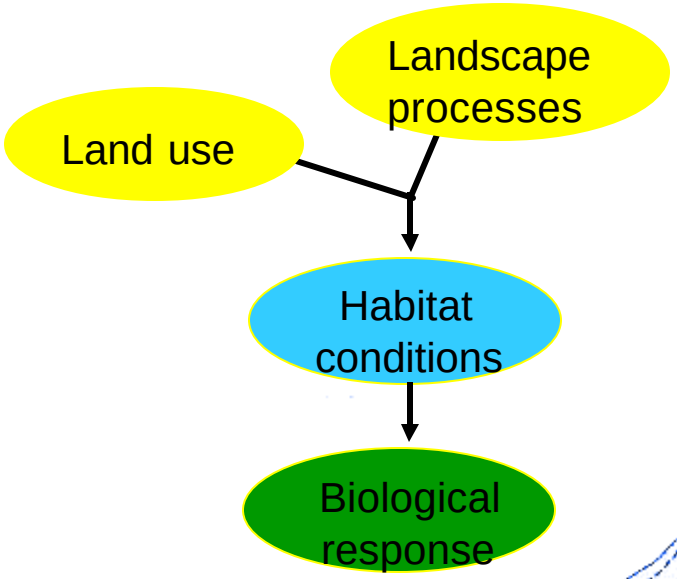
1. Recovering salmon means restoring ecosystem functions
2. Furthering ecosystem approaches to management: science and governance

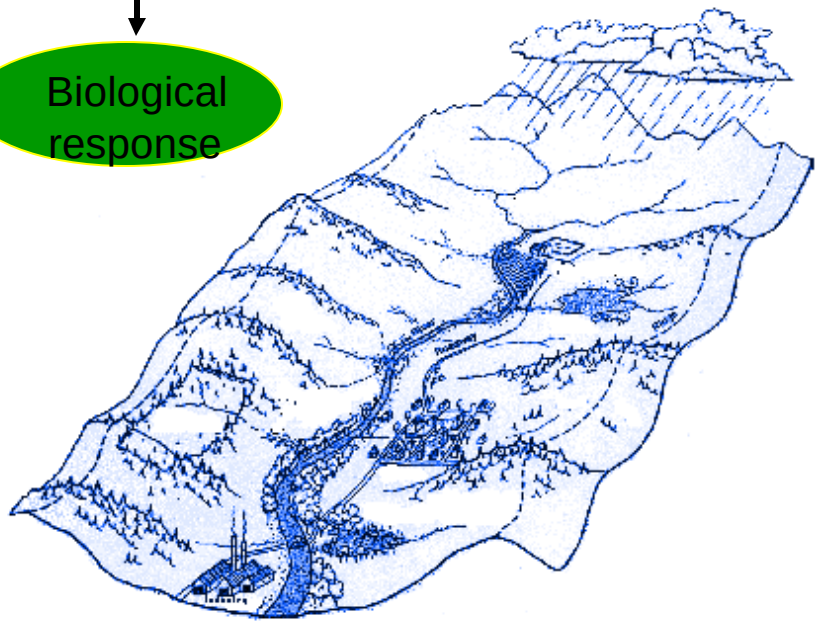
Objective of Puget Sound Salmon Recovery Plan

Recover and maintain an abundance of naturally spawning salmon at harvestable levels

Ecosystem process-based habitat restoration

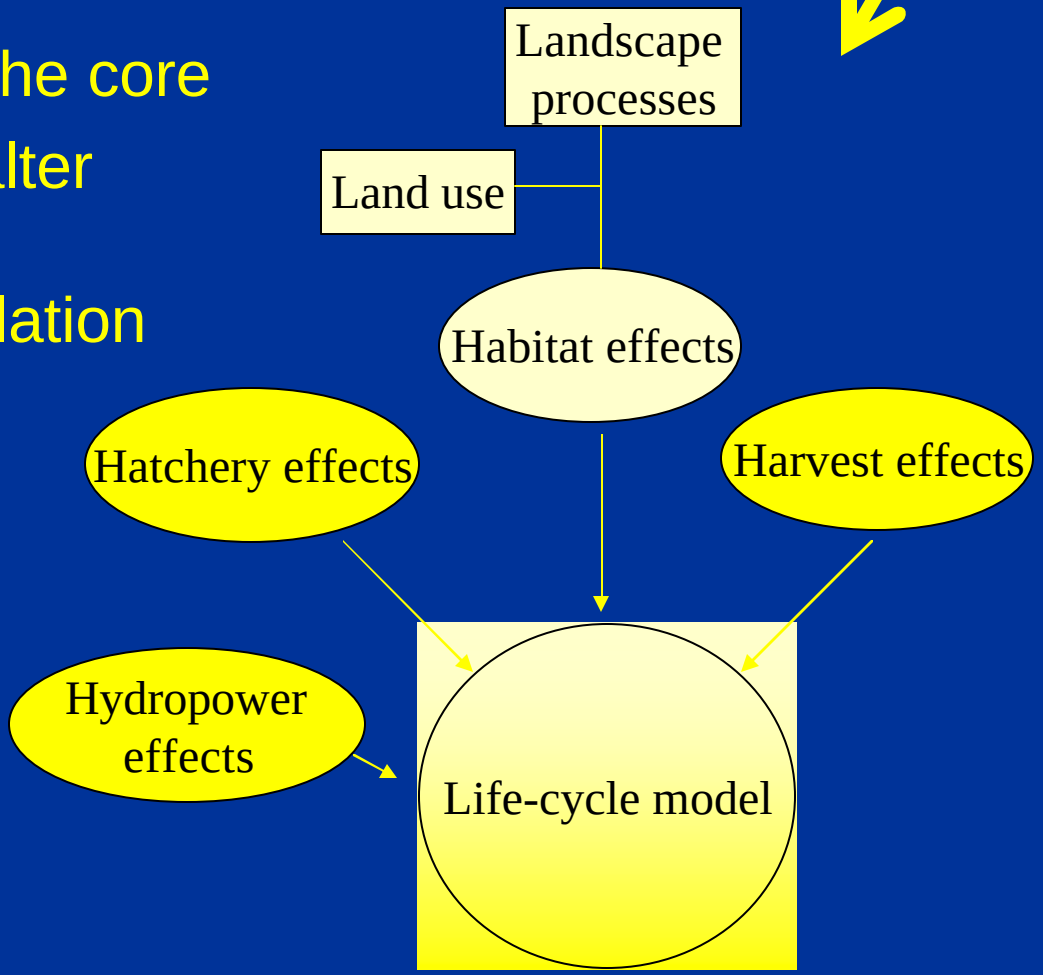
- Focus on re-establishing natural rate and magnitude of processes
- Focus on causes of habitat change and biological response





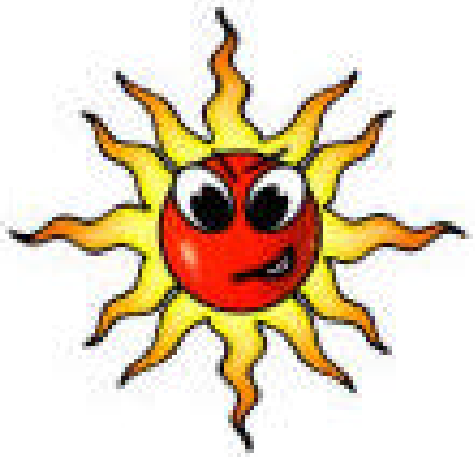
Conceptual foundation

- Life-cycle model is at the core
- Changes to the “H’s” alter habitats, ecological interactions, and population dynamics

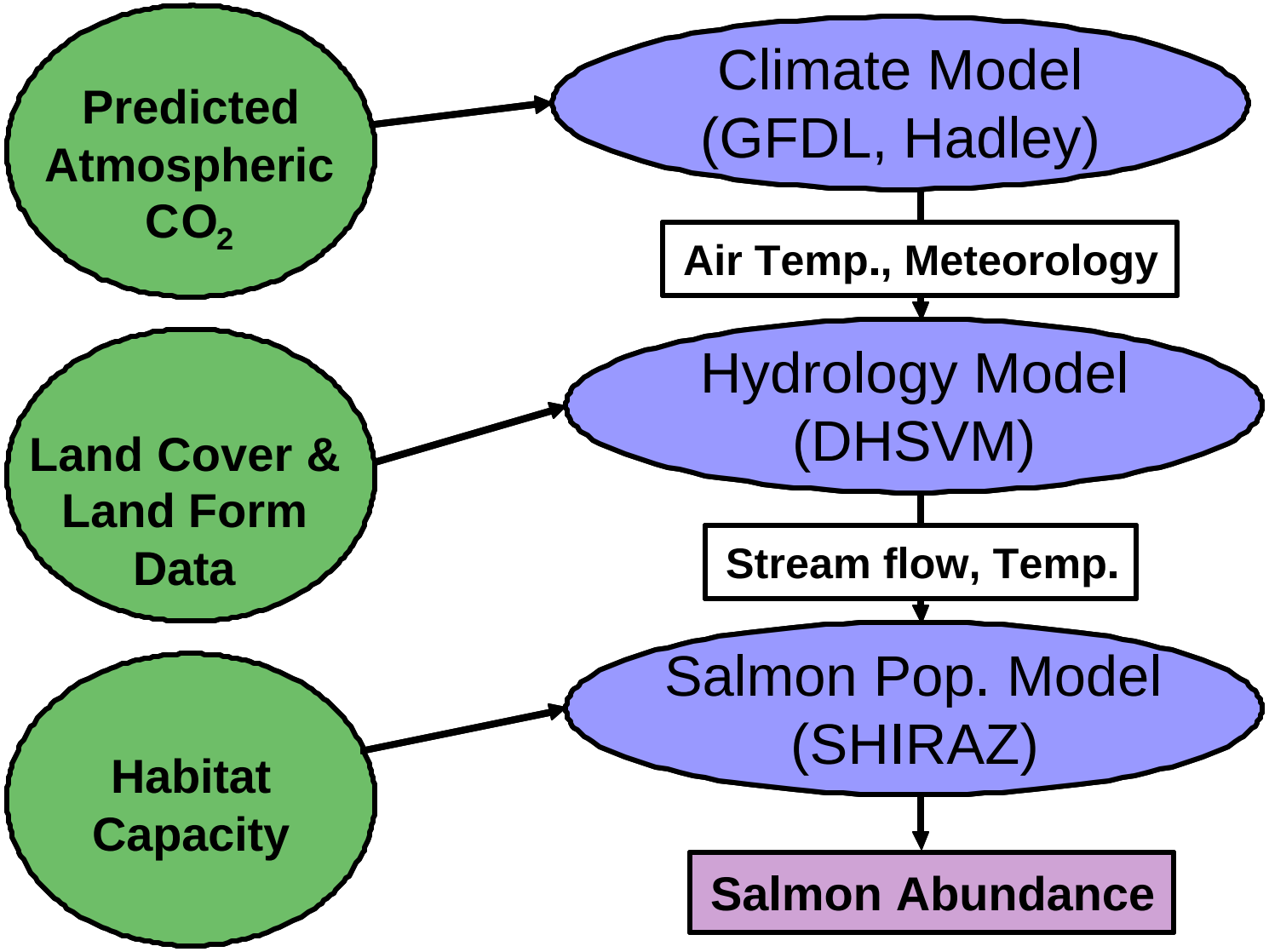


Climate Change Over Next 50 Years in the Northwest

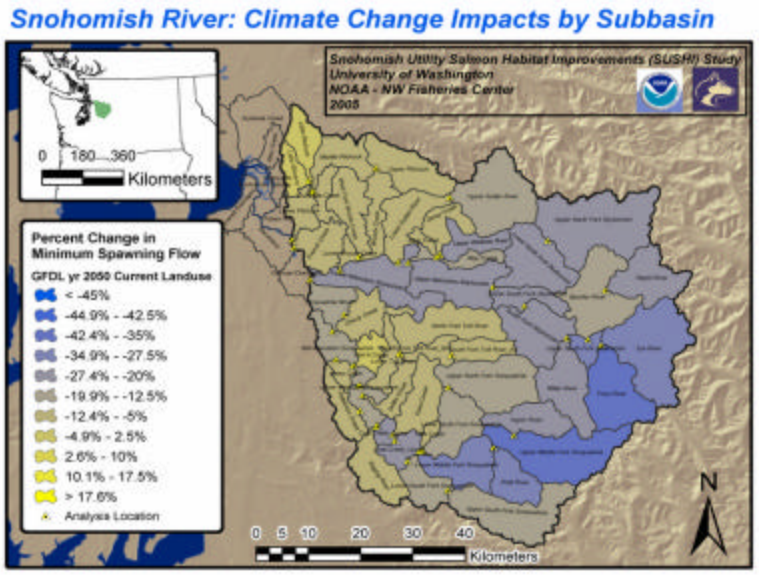
- **Air temp. up 2-4 degrees C → warmer water temps**
- **Earlier snowmelt → more intense winter flooding, lower summer flows**
- **Altered precipitation regime (maybe wetter, esp. in winter) → increased flood magnitude**

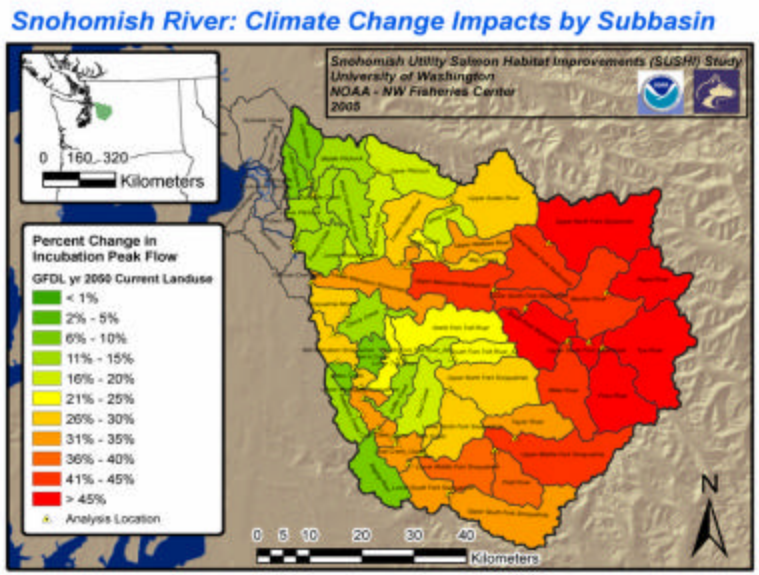


Designing and evaluating recovery strategies with uncertain futures



Global climate impacts on stream flows in the Snohomish watershed





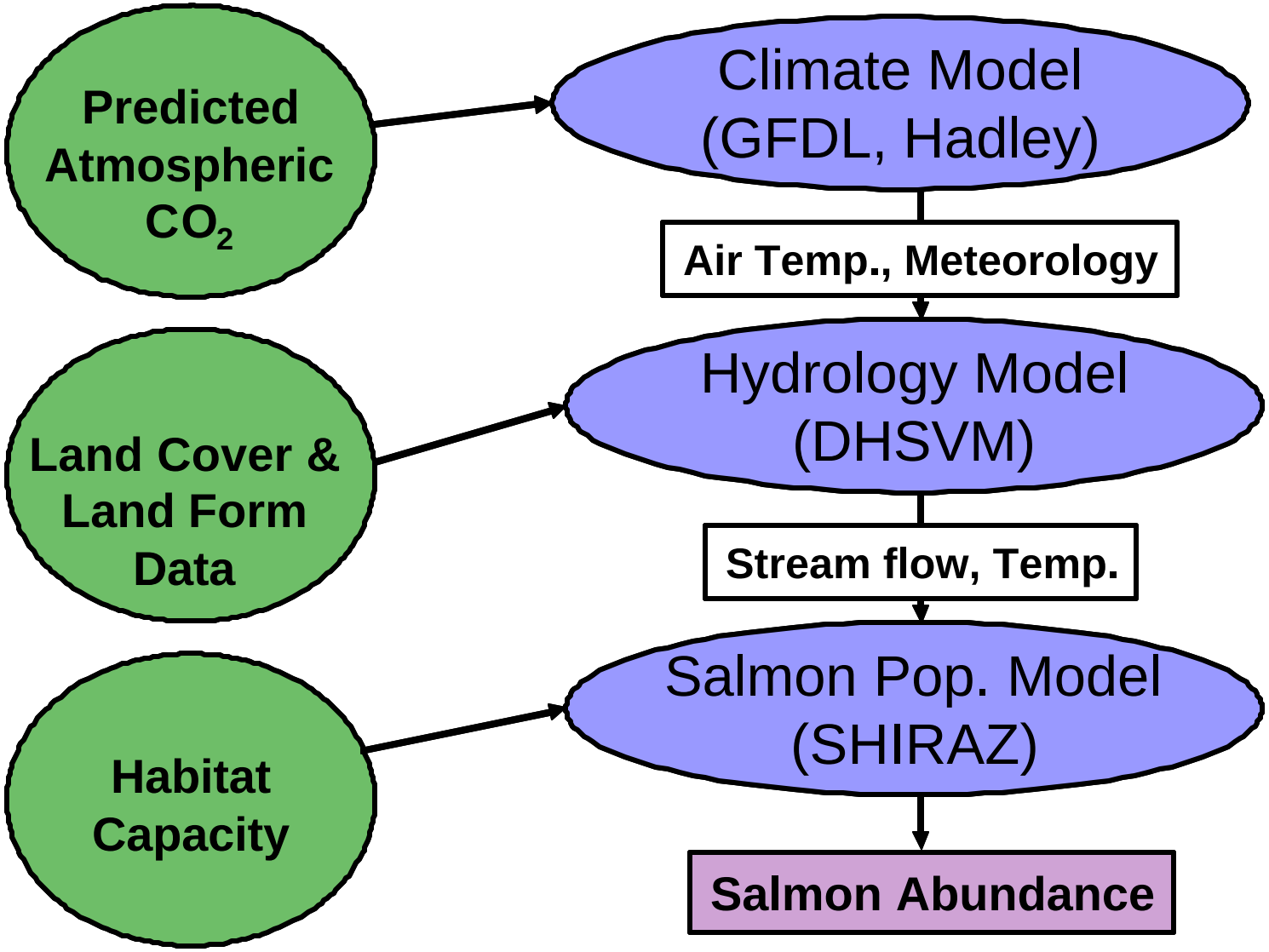
Reductions in minimum spawning flows up to 40%

Increases in peak incubation flows up to 45%

Battin et al. in prep.

Habitat actions we modeled: protecting or restoring ecosystem processes in freshwater and marine habitats for salmon

Designing and evaluating recovery strategies with uncertain futures

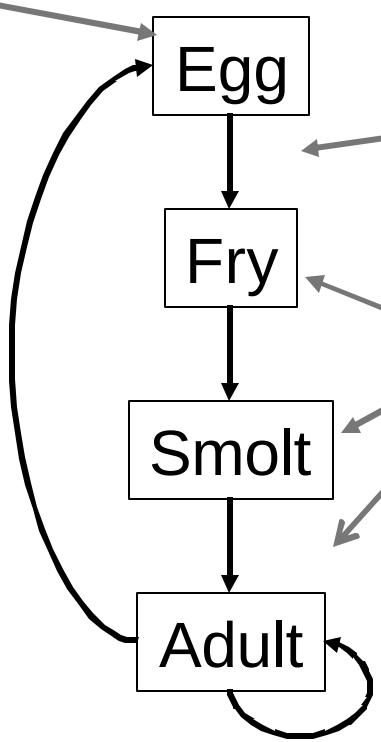


SHIRAZ is a life-cycle model

estimating cumulative effects of suites of actions

Spawning Capacity
stream gradient
stream width
riparian condition
water flows
hatchery spawners

Pre-spawning Survival
stream temperature
harvest



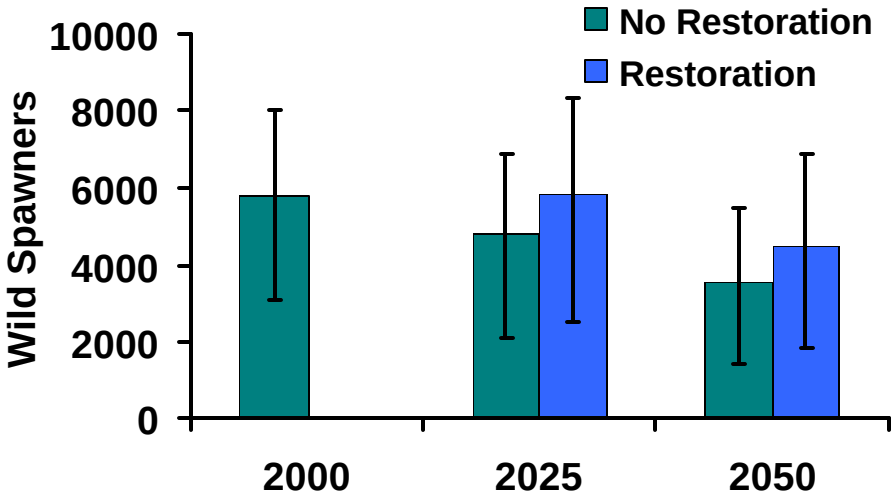
Egg-to-fry Survival
peak flows
sediment
stream temperature

Juv. Rearing Capacity
channel structure
edge habitat
estuary connectivity
hatchery competition

Bartz et al. in press
Scheuerell et al. in press

Can restoration and protection mitigate against future climate impacts?

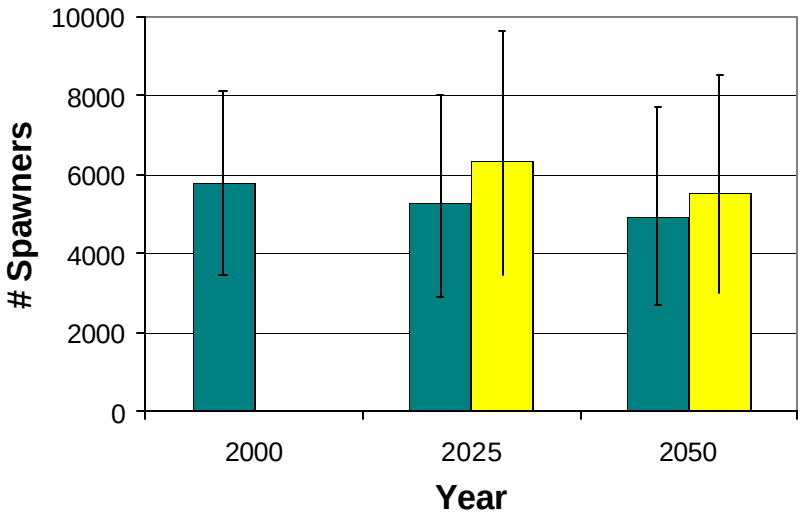
GFDL Model



2000-2050 decline w/o restoration: 39%

2000-2050 decline w/ restoration: 23%

Hadley Model



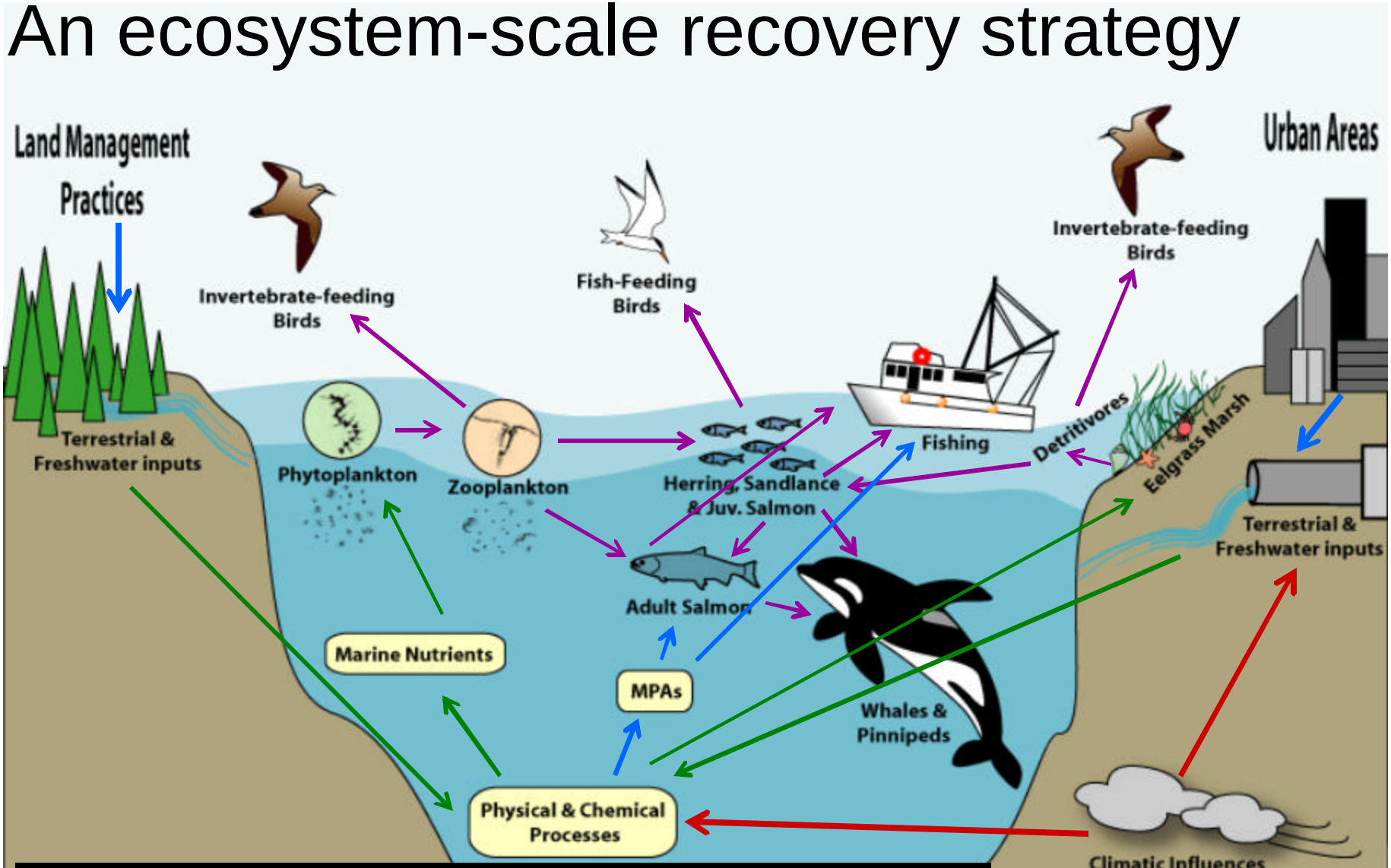
2000-2050 decline w/o restoration: 15%

2000-2050 decline w/ restoration: 5%

Battin et al. in prep.

The rest of the picture……

An ecosystem-scale recovery strategy



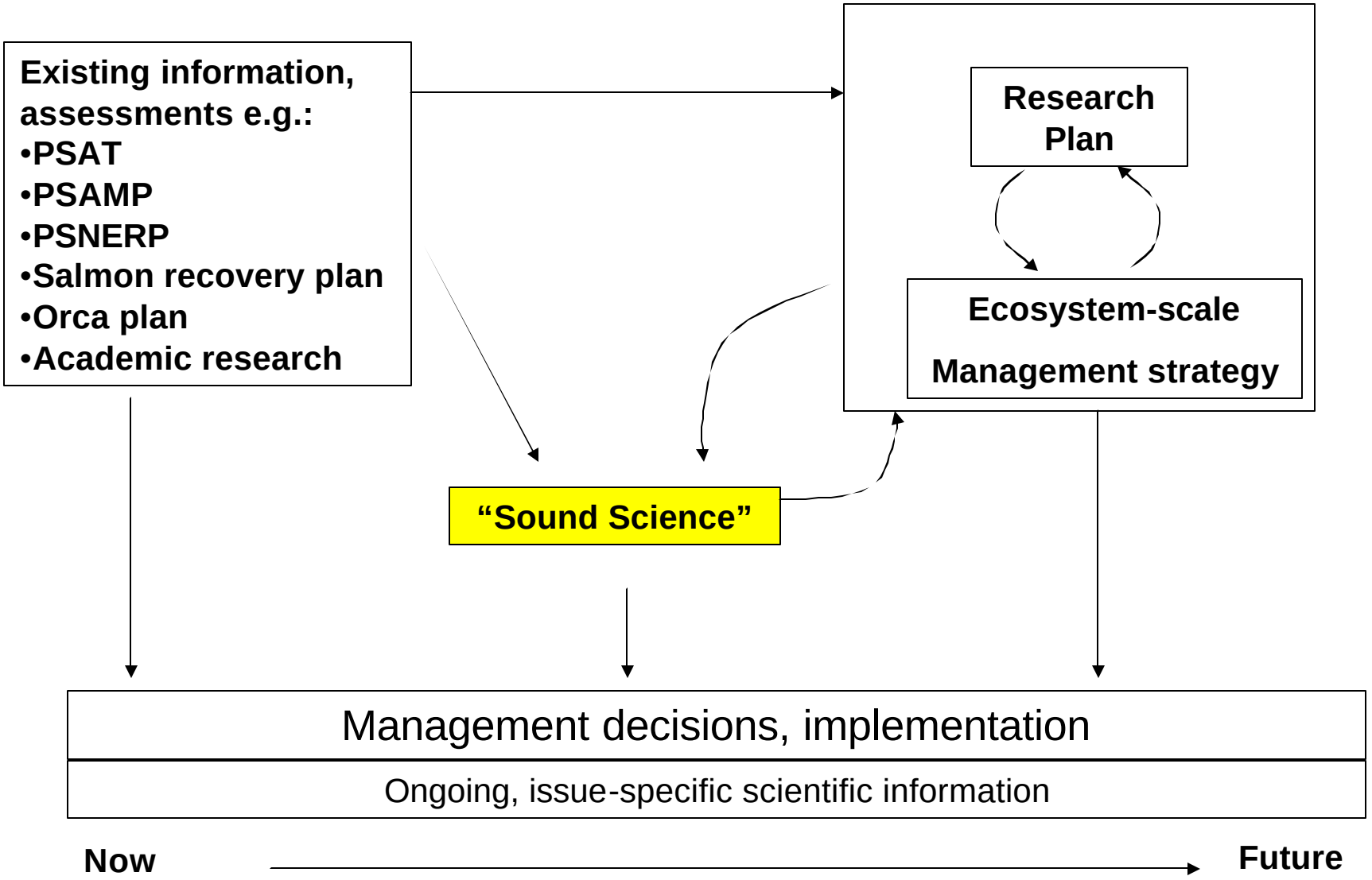
Species: herring, Orca, rockfish, salmon, eelgrass, birds
Human health: harmful algal blooms, shellfish closures, toxics
Freshwater flows

Puget Sound Partnership

Task: develop recommendations for what actions are needed to"…preserve the health, goods and services needed by the year 2020 to ensure that the Puget Sound's marine and fresh waters will be able to support healthy populations of the native species, as well as water quality and quantity to support both human needs and ecosystem functions."

- Set ecosystem goals for 2020
- Identify near-term actions to achieve goals
- Develop a long-term strategy and adaptive management plan for implementation
- Identify key research & monitoring needs
- Design a science-policy governance structure

Contributions of science to ongoing management of Puget Sound



Sound Science document

- Common vision from scientific community on what we know about linkages and functioning of Puget Sound ecosystem (species, habitats, processes, services)
- Primary threats to ecosystem elements
- Key gaps in our scientific understanding
  - E.g.: ecosystem services, ecosystem scale decision-support models……

Ecosystem services as a common currency for EAM

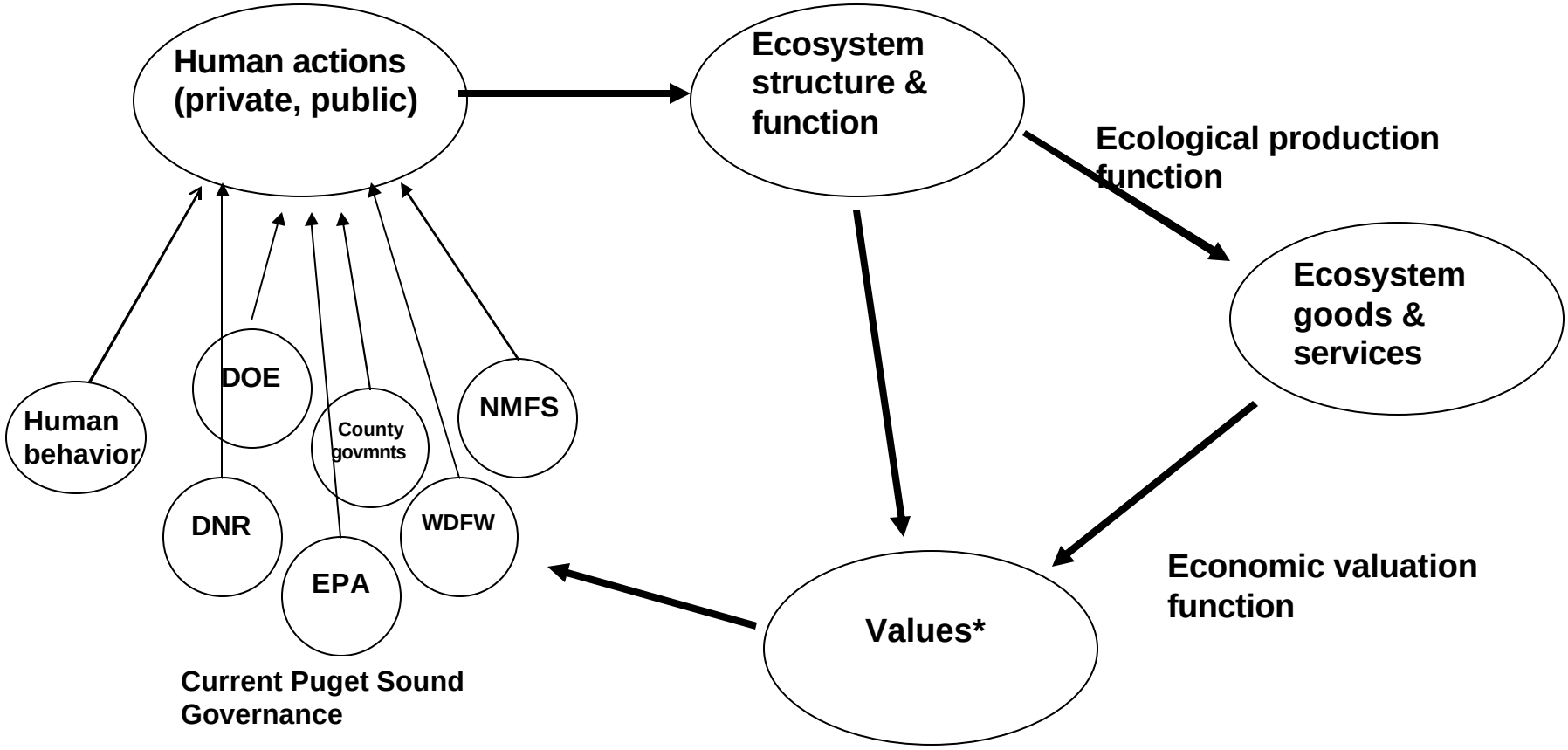
What the public wants:

- Healthy Seafood
- Clean Beaches
- Stable fisheries
- Abundant wildlife
- Vibrant Coastal Communities

Pew and U.S. Ocean Commissions

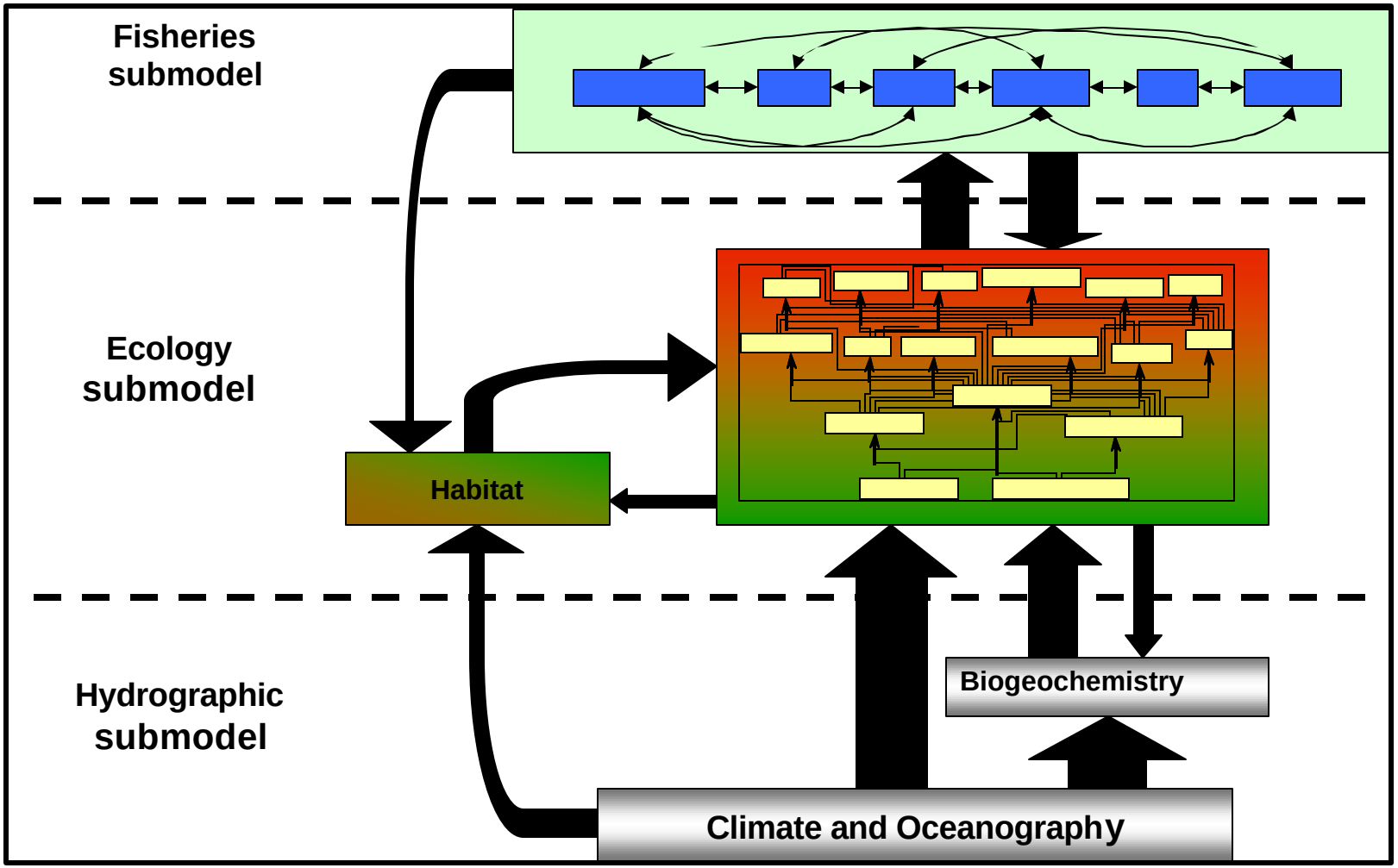
What scientists can value:

- Flood, toxics & climate regulation
- Fresh water and food provisioning
- Nutrient cycling
- Aesthetic, commercial, and recreational values



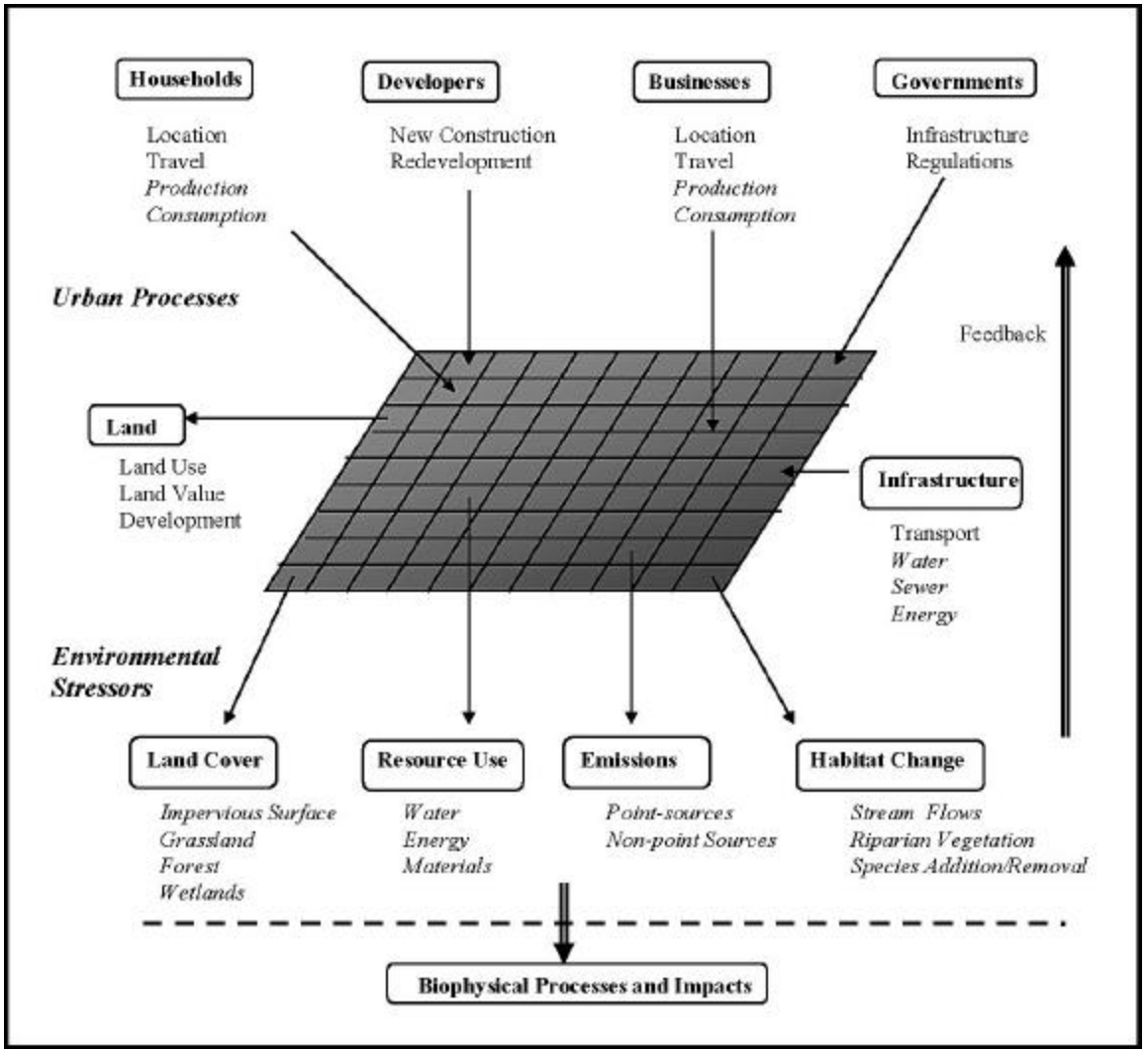
*e.g., harvesting, water supply, recreation, transportation, aesthetics, flood, erosion, and pollution control, human health, cultural heritage, species and biodiversity preservation.

ATLANTIS model: example of integrating ecosystem elements



Fulton et al. 2003, Levin et al. in prep.

UrbanSim: example of linking natural ecosystem and human system models



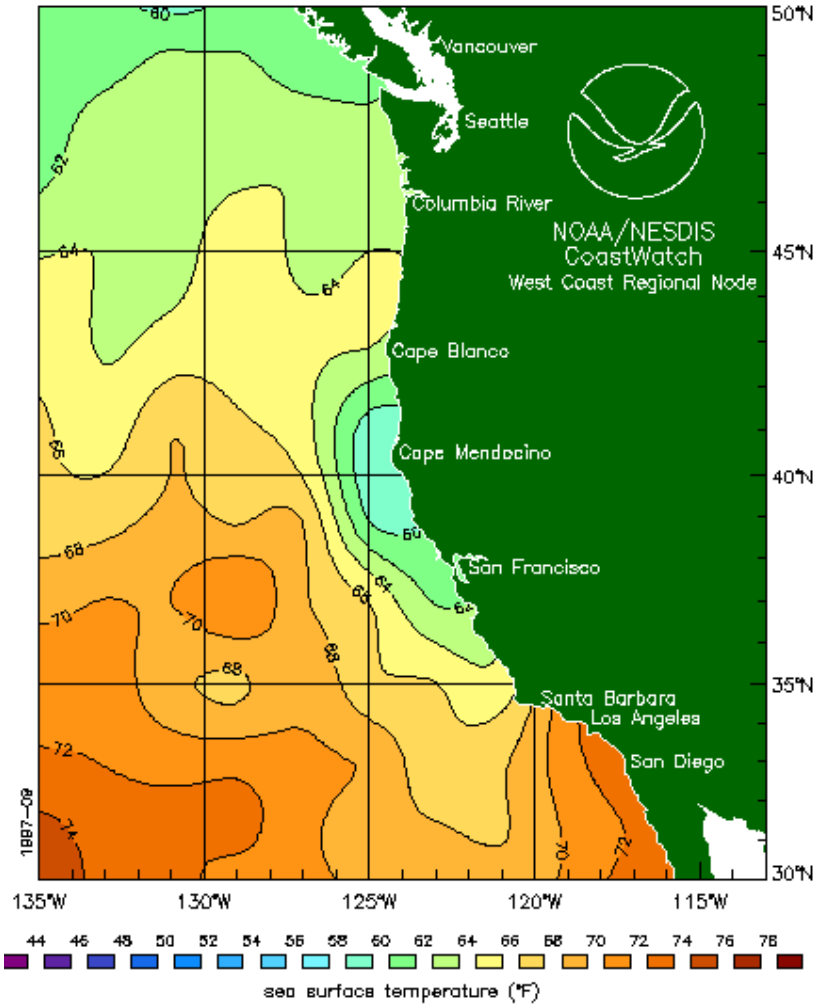
Waddell 2002

Sound Science: preliminary findings—key factors affecting management of PS ecosystem:

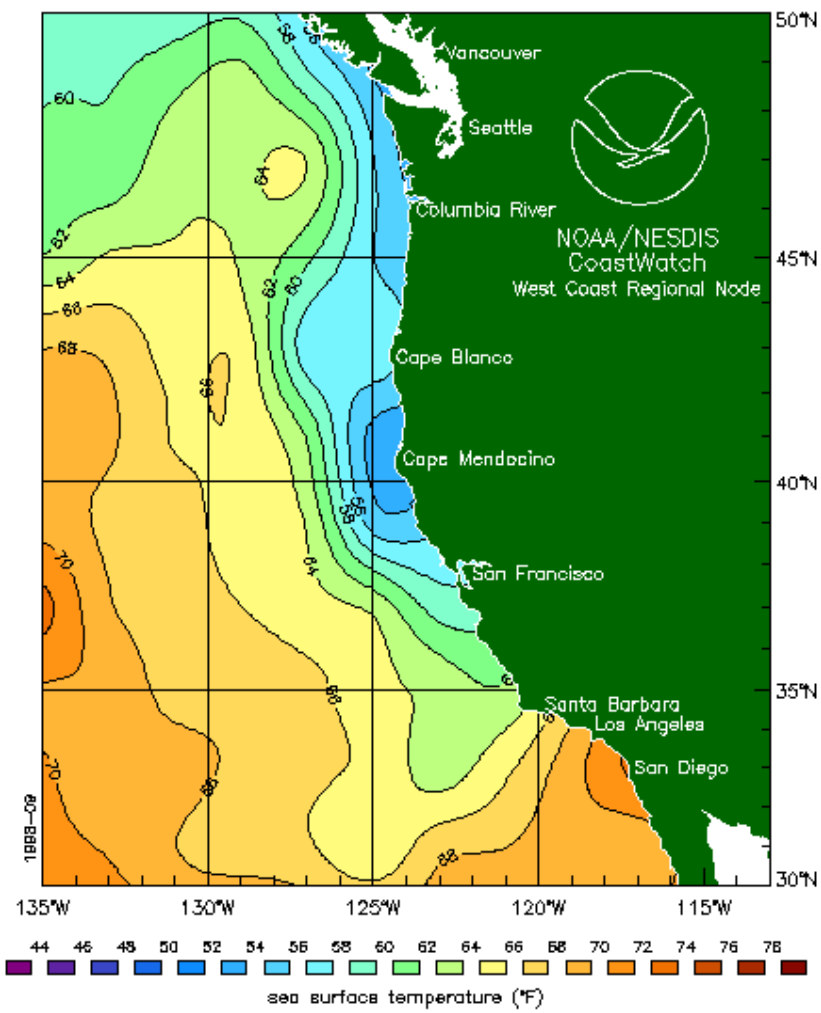
- Climate impacts on FW peak and low flows
- Increases in human population density on land uses, runoff
- Food web impacts on species recovery
- Changes in ecosystem services due to changes in ecological functioning

West-coast sub-arctic habitat is dynamic and sensitive to changing wind patterns (e.g., El Niño, La Niña, the Pacific Decadal Oscillation (PDO))

Sept 1997 El Niño

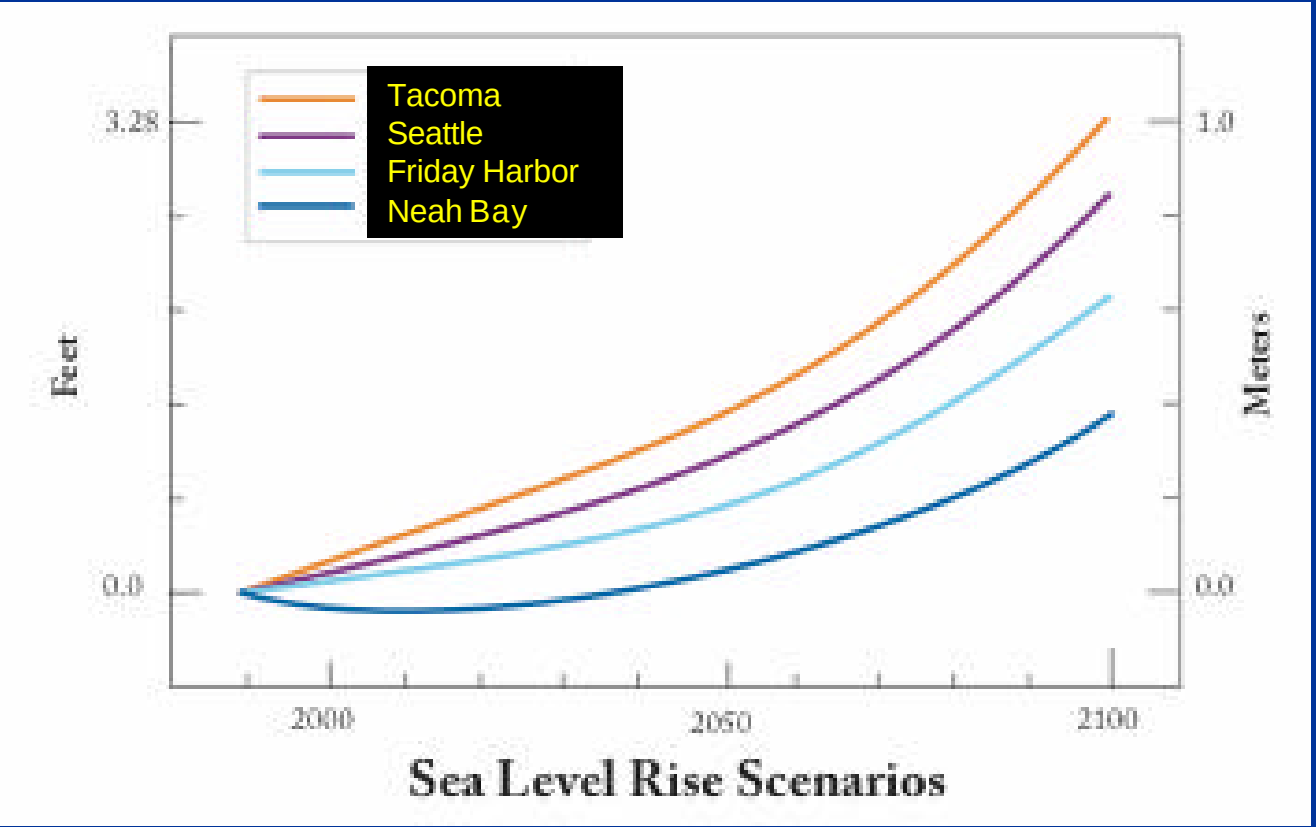


Sept 1998 La Niña



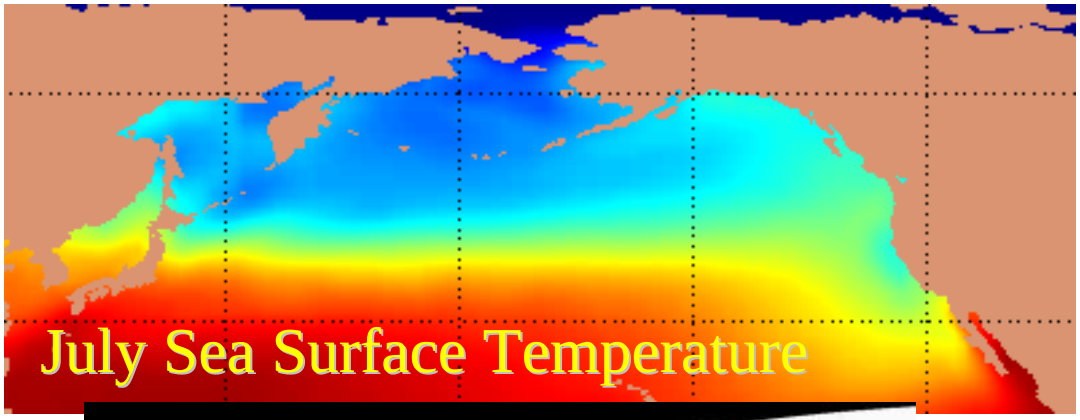
Sea Level Rise

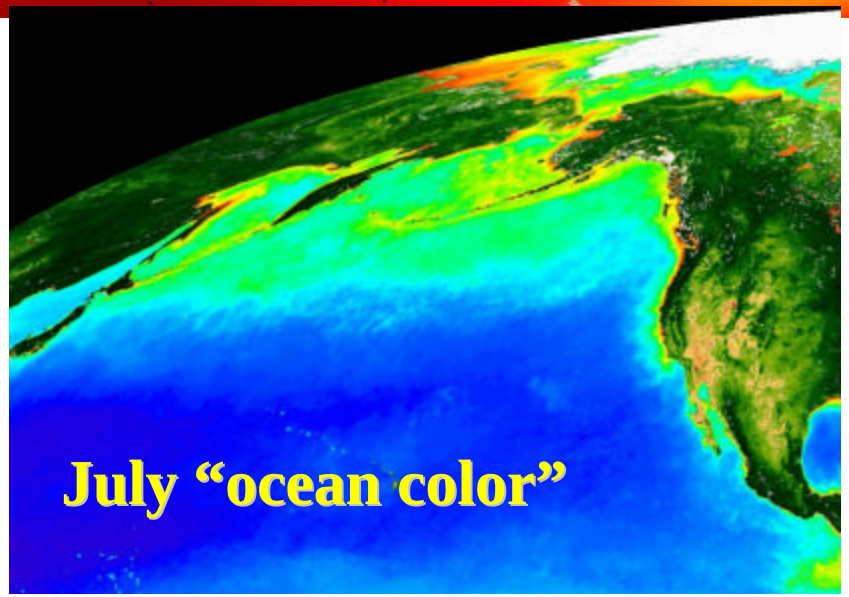
- sea level rise is projected to be most rapid in south Puget Sound where land is sinking most rapidly

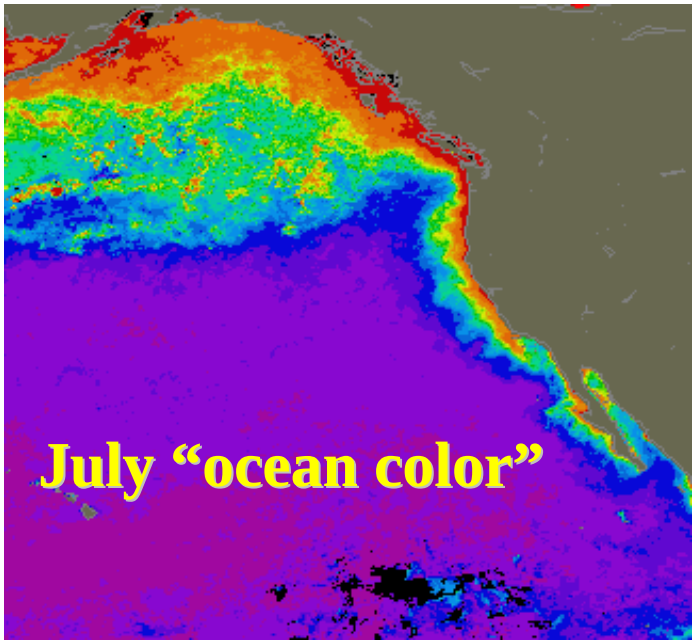


PSAT 2005

Pacific salmon habitat: **productive sub-arctic (cool-fresh-nutrient rich) waters from Japan to California -- coastal upwelling extends this habitat south to S. Cal.**

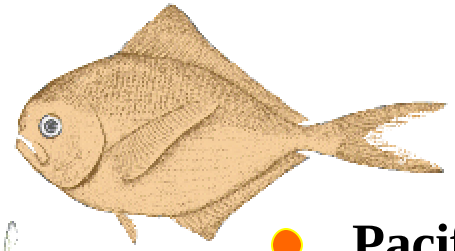




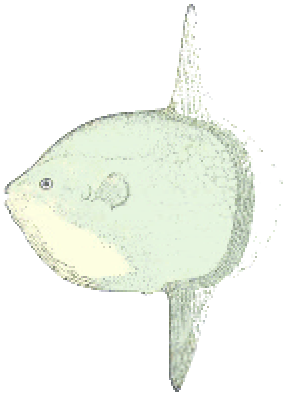


SeaWiFS images from NASA’s Goddard Space Flight Center
http://seawifs.gsfc.nasa.gov/SEAWIFS.html

Exotic Species Sightings off the BC Coast During 1983, an extreme El Niño year (J. Fulton, P.B.S.)



Pacific Pomfret
(*Brama japonica*)



Ocean Sunfish
(*Mola mola*)

Chub mackerel
(*Scomber japonicus*)

Pacific Bonito
(*Sarda chiliensis*)

(Pelicanus occidentalis)

Slide provided by Kim Hyatt, DFO